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1977 DWARF MISTLETOE LOSS ASSESSMENT SURVEY MEDICINE BOW NATIONAL FOREST, WYOMING

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ABSTRACT

As part of an effort to assess growth loss and mortality caused by dwarf mistletoe, Arceuthobium americanum, *in western coniferous forests, two approaches were used to estimate annual cubic-foot volume loss in lodgepole pine forests on the Medicine Bow National Forest in Wyoming. The first approach was to use data derived from a 1970-71 Stage I timber inventory (available from Timber Management, Rocky Mountain Region), and the second was to conduct a road-plot survey to estimate dwarf mistletoe incidence and associated volume loss. Results indicate that existing mistletoe data in timber inventory files are inadequate when trying to develop growth loss information.*

INTRODUCTION

During 1977, a pilot survey was conducted on the Medicine Bow National Forest in Wyoming. The purpose of this survey was to evaluate existing extensive timber inventory data (from Stage I) which included a tally of dwarf mistletoe-infected trees on inventory plots (U.S. Forest Service 1976). These timber inventory data were compared with results of a road-plot survey conducted by forest pathologists. Survey objectives were to test our ability to estimate green stand parameters, determine if Stage I timber inventory crews accurately evaluated dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm., incidence and intensity on lodgepole pine, *Pinus contorta* Dougl. ex Loud., and to estimate annual cubic-foot volume loss due to lodgepole pine dwarf mistletoe for the entire Forest.

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METHODS

The survey was conducted in two stages, the first a roadside reconnaissance, and the second a series of variable plots located at intervals along roads through lodgepole pine stands. Type maps were used to exclude obvious areas of non-host type. Stands above 9800 ft. (3000 m) elevation were also excluded since *A. americanum* does not occur above this elevation on the Medicine Bow National Forest (Hawksworth 1956). Inventory data were used to provide acreage estimates for the lodgepole pine type on the Forest.

Road Survey

Two-man crews traversed roads at approximately 10 miles per hour and recorded the mileage to the nearest 1/10th mile whenever there was a detectable change in forest type, tree size class, or dwarf mistletoe infection level. The right side of the road was evaluated to a distance of 1 chain from the road for mature stands and 1/2 chain in pole and seedling-sapling stands. The percent area of lodgepole pine type affected was estimated by determining the ratio of miles of lodgepole pine type with infected trees to the total number of miles of lodgepole pine type traversed.

Intensity of dwarf mistletoe infection was recorded as none, light, moderate, or heavy. Light was defined as less than one-third of the trees in the predominant size class infected; moderate, one-third to two-thirds of the trees infected; and heavy, greater than two-thirds of the trees were infected. The speed of the vehicle prevented evaluation of each tree using Hawksworth's system (Hawksworth 1977).

Plot Survey

Variable radius plots (BAF 10) were established at 3-mile intervals along the roads. Plots were located 2 chains into the forest at right angles to the road being traversed. Plots were established on the right side of the road; however, if the plot was located in non-type then the left side of the road was used. If both sides were non-type, the plot was rejected without replacement.

Basal area was estimated for each of the 107 plots established. Diameter at breast height (DBH) and dwarf mistletoe rating (DMR) (Hawksworth 1977) were recorded for each tree 5 inches or more in diameter. Height was measured for one tree and estimated for the remaining trees on each plot. A 1/100-acre fixed plot was also established to evaluate dwarf mistletoe incidence and intensity in reproduction. Trees less than 5 inches DBH and greater than 6 feet in height were inspected for the presence or absence of dwarf mistletoe using the Hawksworth system. Data from plots with similar attributes, size class for example, were combined to represent approximately 70 stands.

The RMYLD simulation model (Edminster 1978) was used to estimate cubic-foot volume loss from dwarf mistletoe for each stand, based on the average DMR calculated from those plots that were combined to make up the stand. This loss estimate was derived by making two consecutive runs of the model, the first with average DMR's derived from the data, and the second with all DMR's converted to zero to represent non-infected stands. The latter simulates growth in all stands over the next 10-year period as if no dwarf mistletoe infection were present.

Evaluation of Stage I Timber Inventory Data

Region 2 timber inventory data were accessed to provide a summary of green stand data for 92 Stage I inventory plots within the lodgepole pine type in the Medicine Bow National Forest. Data for the following parameters were transposed to a summary sheet and were segregated by computer into the following categories:

Site index (5 categories)

a. 40 - 49
b. 50 - 59
c. 60 - 69
d. 70 - 79
e. 80+

Dwarf mistletoe infection level (4 categories[4])

a.	no infection	(0)
b.	light (L)	1 - 60% of trees infected
c.	moderate (M)	60 -81% of trees infected
d.	heavy (H)	greater than 81% of trees infected

Basal area (5 categories)

a. 0 - 50 $ft.^2$
b. 51 - 100 $ft.^2$
c. 101 - 150 $ft.^2$
d. 151 - 200 $ft.^2$
e. greater than 200 $ft.^2$

Using the above categories, similar plot data were segregated into 65 hypothetical stands. The RMYLD simulator was used to estimate growth loss in the same manner as previously described for the road-plot survey.

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4 L = levels 1 and 2; M = levels 3 and 4; H = levels 5 and 6, in the Hawksworth dwarf mistletoe rating system.

RESULTS

Disease incidence refers to the presence or absence of dwarf mistletoe on the timber inventory or survey plot, and does not reflect an evaluation of disease severity.

Estimates of incidence of dwarf mistletoe on the Medicine Bow National Forest acquired from the two sources were compared (Table 1). It shows that 47% of the Stage I timber inventory plots contained one or more mistletoe infected trees. Dwarf mistletoe was present on 55% of the lodgepole pine acreage represented by those plots. The road survey conducted in 1977 revealed that 60.5% of the 440 miles traversed were adjacent to mistletoe-infested stands and 60% of the plots established in conjunction with the road survey contained mistletoe-infected trees.

Table 1. Dwarf mistletoe incidence on the Medicine Bow National Forest.

Source	Parameter	Percent
Stage I Timber Inventory	plots with mistletoe	47.0
	acres with mistletoe	55.0
1977 Survey	miles with mistletoe	60.5
	plots with mistletoe	60.0
Hawksworth's Survey (1958)	miles with mistletoe	59.0

A Chi-square test (Snedecor and Cochran 1967) comparing incidence of dwarf mistletoe for the Stage I inventory plots and the 1977 road survey showed that there was only a 10% chance that the difference could be explained by sampling error. Hawksworth (1958) reported that 59% of the miles traversed on the Medicine Bow National Forest contained mistletoe-infected trees. Average total volume derived from the Stage I timber inventory was 2302 cubic feet per acre. The 1977 road survey estimate was 2213 cubic feet per acre. These estimates are not statistically different.

All data sources produced similar estimates of dwarf mistletoe incidence, and the plot portion of the road survey and the Stage I timber inventory produced comparable estimates of average total cubic foot volume per acre. A large discrepancy occurred, however, in the acreage and corresponding cubic-foot volume loss estimates for each dwarf mistletoe severity category (Table 2). A test for significance in trends of ordered classification (increasing dwarf mistletoe severity) (Snedecor and Cochran 1967) indicated a significantly higher number of plots and represented acres in the more severe categories for the road-plot survey. The survey conducted by forest pathologists resulted in greater acreage estimates for the higher severity classes of dwarf mistletoe infection and a concomitant increase in total volume loss.

Table 2. Comparison of annual cubic foot volume loss estimates due to lodgepole pine dwarf mistletoe for the Medicine Bow National Forest, derived from Stage I Timber Inventory and 1977 Plot Surveys.

DWARF MISTLETOE SEVERITY CATEGORY	THOUSANDS OF ACRES REPRESENTED		ANNUAL CUBIC FOOT VOL. LOSS	
	STAGE I TIM. INV.	1977 PLOT SURVEY	STAGE I TIM. INV.	1977 PLOT SURVEY
0	158	182	0	0
0.1 - 1.0	138	38	0	0
1.1 - 2.0	37	17	20,780	7,015
2.1 - 3.0	12	10	72,857	56,087
3.1 - 4.0	4	47	49,776	871,891
4.1 - 5.0	4	60	17,880	2,879,211
5.1 - 6.0	-	21	-	194,044
TOTAL	353	375	161,300	4,008,250

These results indicate that while timber inventory crews were able to recognize whether or not dwarf mistletoe was present on inventory plots, as revealed by the consistency of the results in Table 1, they consistently underestimated the intensity of the infection. This is further illustrated by the fact that 34% of the acreage was represented by average dwarf mistletoe ratings of 3.1 or greater for the 1977 survey plot data, while, according to the timber inventory data, only 3% of the acreage contained stands that had average dwarf mistletoe ratings greater than 3.1.

DISCUSSION AND CONCLUSIONS

The results of the pilot survey, when compared to those of Timber Inventory, indicate that mistletoe data presently in inventory files is inadequate. Despite the difference in volume loss estimates attributed to dwarf mistletoe obtained from timber inventory data and from specific dwarf mistletoe surveys, we feel that if the source of error in existing data can be corrected in the future the timber inventory data base is the most logical place to maintain data on insect and disease pests that have significant impact on forest productivity.

It is essential that timber inventory crews recognize the major insect and disease pests in order to improve the reliability of the inventory data base. Training of inventory crews by insect and disease specialists may fill this need, or possibly providing one well trained individual per crew would suffice.

In the future timber inventory and insect and disease specialists must cooperate in the development and evaluation of inventory systems, and where possible develop and utilize simple systems for rating major pests, such as the 6-class dwarf mistletoe rating (Hawksworth 1977).

Such data would be useful to managers at all administrative levels. The land manager would find the information useful in establishing the priority of stands for treatment and scheduling harvests. At the Regional Office level these data would be useful in the preparation of forest plans and developing Regional priorities. At the highest administrative level the data would be useful in the evaluation and funding of research, administrative studies, and pest control projects.

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